

(19) World Intellectual Property Organization  
International Bureau(43) International Publication Date  
16 August 2001 (16.08.2001)

PCT

(10) International Publication Number  
WO 01/59937 A3(51) International Patent Classification<sup>7</sup>: H04B 1/707,  
H04L 27/00

(21) International Application Number: PCT/US01/02747

(22) International Filing Date: 26 January 2001 (26.01.2001)

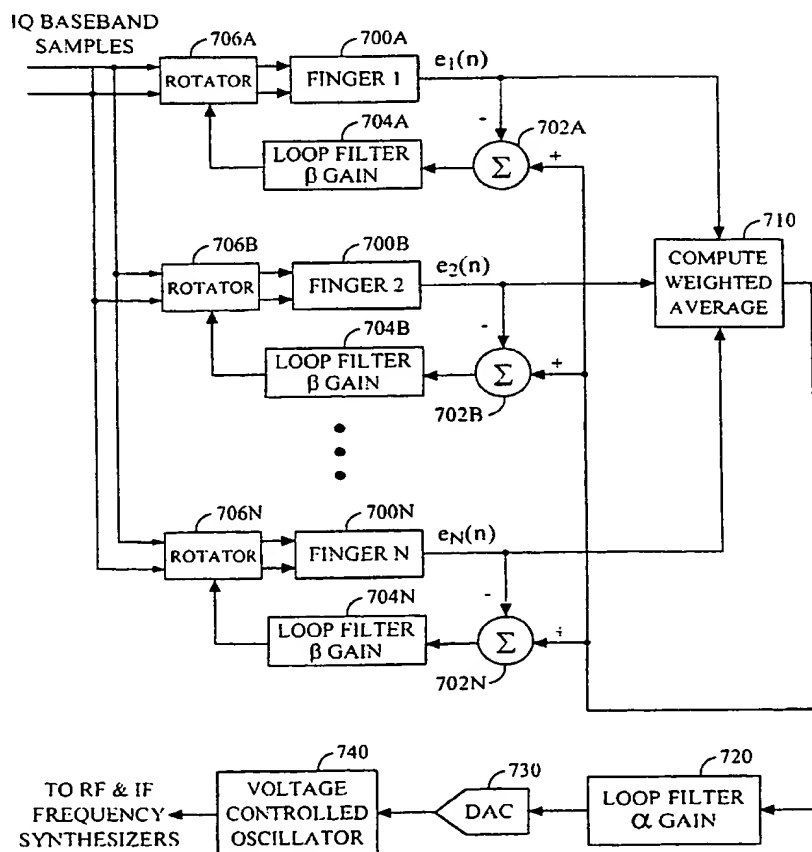
(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
09/491,349 26 January 2000 (26.01.2000) US(71) Applicant: QUALCOMM INCORPORATED [US/US]:  
5775 Morehouse Drive, San Diego, CA 92121-1714 (US).(72) Inventors: AGRAWAL, Avneesh: 809 Pitkin Loop, San  
Jose, CA 95125 (US). SIH, Gilbert: 7804 Pipit Place.San Diego, CA 92129 (US). ROH, Mark: 9624 Caminito  
del Feliz, San Diego, CA 92121 (US). BUTLER, Brian:  
8736 Glenwich Lane, La Jolla, CA 92037 (US). CHALLA,  
Raghu: 9494 Carroll Canyon Road #61, San Diego, CA  
92126 (US).(74) Agents: WADSWORTH, Philip, R. et al.: Qualcomm In-  
corporated, 5775 Morehouse Drive, San Diego, CA 92121-  
1714 (US).(81) Designated States (national): AE. AG. AL. AM. AT. AU.  
AZ. BA. BB. BG. BR. BY. BZ. CA. CH. CN. CR. CU. CZ.  
DE. DK. DM. DZ. EE. ES. FI. GB. GD. GE. GH. GM. HR.  
HU. ID. IL. IN. IS. JP. KE. KG. KP. KR. KZ. LC. LK. LR.  
LS. LT. LU. LV. MA. MD. MG. MK. MN. MW. MX. MZ.  
NO. NZ. PL. PT. RO. RU. SD. SE. SG. SI. SK. SL. TJ. TM.  
TR. TT. TZ. UA. UG. UZ. VN. YU. ZA. ZW.(84) Designated States (regional): ARIPO patent (GH. GM,  
KE. LS. MW. MZ. SD. SL. SZ. TZ. UG. ZW); Eurasian

[Continued on next page]

(54) Title: MULTIPATH DOPPLER-ADJUSTED FREQUENCY TRACKING LOOP



(57) Abstract: A novel and improved method and apparatus for frequency tracking is described. Two main sources of error that contribute to the frequency difference between locally generated carriers and those used to modulate received signals include frequency offset between the two timing sources and doppler effects due to relative movement between the sources. The present invention provides a tracking mechanism for removing the effects of error due to frequency offset as well as compensation for frequency error due to doppler in a plurality of multipath signals. Each finger (700a..700n) of a RAKE receiver utilizing the present invention will compute a frequency error for that finger. The weighted average of all of these frequency errors is calculated (710) and filtered (720) to provide a control signal for varying the frequency of IF and RF frequency synthesizers, accounting for the common frequency offset seen at each finger. Additionally, each finger is equipped with a rotator (706a...706n) for providing frequency adjustment specific to that finger. The frequency of each finger is adjusted through feedback of the frequency error finger.

WO 01/59937 A3



patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European  
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,  
IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF,  
CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:** ✓

— with international search report

(88) Date of publication of the international search report:

31 January 2002

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

International Application No  
PCI/US 01/02747

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H04B1/707 H04L27/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H04B H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X A	WO 00 38343 A (KONINKL PHILIPS ELECTRONICS NV) 29 June 2000 (2000-06-29) abstract; claims 1-10; figure 3  page 7, line 27 -page 8, line 7 page 9, line 12 -page 11, line 2 page 5, line 10 -page 7, line 10 ---	1-9, 15-17 10-14, 18-22
A	US 5 659 573 A (BRUCKERT EUGENE J ET AL) 19 August 1997 (1997-08-19) claim 1; figures 4,8 column 11, line 13 -column 12, line 15 column 12, line 52 -column 13, line 1 ---	1-22
A	EP 0 675 606 A (NIPPON TELEGRAPH & TELEPHONE) 4 October 1995 (1995-10-04) abstract; figures 1-3 page 3, line 52 -page 4, line 3 -----	1-22

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

**\* Special categories of cited documents :**

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

24 July 2001

Date of mailing of the international search report

31/07/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.  
Fax: (+31-70) 340-3016

Authorized officer

Amadei, D

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/02747

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0038343 A	29-06-2000	EP 1057282 A	06-12-2000
US 5659573 A	19-08-1997	BR 9506385 A	16-09-1997
		CA 2176945 A	11-04-1996
		CN 1136378 A	20-11-1996
		EP 0732022 A	18-09-1996
		FI 962326 A	04-06-1996
		IL 114836 A	27-12-1998
		JP 9507014 T	08-07-1997
		KR 227452 B	01-11-1999
		PL 314846 A	30-09-1996
		WO 9610879 A	11-04-1996
		US 5619524 A	08-04-1997
EP 0675606 A	04-10-1995	US 5594754 A	14-01-1997
		CN 1115590 A, B	24-01-1996
		WO 9510891 A	20-04-1995
		JP 2764153 B	11-06-1998